The C.W. Brabender® „3-Phase-System“
Tools for Quality Control, Research and Development

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Brabender® GmbH & Co.KG Duisburg - Germany

...where quality is measured.
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1923 C.W. Brabender® Elektromaschinen, founded by Carl Wilhelm Brabender, Duisburg

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2012  The Brabender® group today

- **Brabender® GmbH & Co. KG Duisburg, Germany**
  - Laboratory equipment for food and plastic industry
- **Brabender® GmbH & Co. KG Moscow, Russia**
  - Responsible for Russia and former USSR countries
- **C.W.Brabender® Instruments Inc. (New Jersey, USA)**
  - Responsible for the markets in America
- **Brabender® Technologie KG, Duisburg**
  - Feeders, and flow meters for bulk solids
- **Brabender® Messtechnik® GmbH & Co. KG Duisburg**
  - Aquatrac, Instruments for the plastic industry

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The C.W. Brabender® 3-Phase-System
1. History of Brabender®

- Research and Development
- Brabender®-Group with about 400 employees
- 116 agencies in more than 110 countries worldwide
- Over 17 years constantly certified DIN EN ISO 9001

Duisburg, Germany

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The Brabender® 3-Phase-System
1. History of Brabender®

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The Brabender® 3-Phase-System
1. History of Brabender®

Food: Application laboratory

1930

2012

Training, sample testing, new developments, research, cooperations…

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The Brabender® 3-Phase-System
2. From grain to bread

Over 30 instruments for standard and customer specified tests available,…

Mills      Moisture      NIR       Mixing         Stretching       Gelling

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The Brabender® 3-Phase-System
2. From grain to bread

Laboratory instruments - examples

**Sample Preparation**
- Cleaning
- Separation
- Milling

**Moisture Content**
- Determination of water content

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Quadrumat® Junior

Moisture Tester MT-C
The Brabender® 3-Phase-System
2. From grain to bread – Sample preparation

Automatic multi-step grinding process with 4-roll milling system and one round sifter.

Quadrumat® Junior

AACC 26-50

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Five different sifter arrangements are possible to simulate the milling process in the millhouse.

Quadrumat® Senior

BIPEA BY 102.D.9302

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The Brabender® 3-Phase-System
2. From grain to bread

Brabender® Rapid Moisture Tester MT-C

Whole meal
Flours, bran, tobacco…..
10 samples capacity

ICC 110/1, ISO 712. VO[EU] 2182/2005

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The C.W. Brabender® 3-Phase-System
3. C.W. Brabender’s vision: The 3 phase system

Brabender® Farinograph®

Brabender® Extensograph®

Brabender® Amylograph®
Raw materials

- Composition (protein, moisture, ash, fat,…)
- Properties of ingredients
- Final: Quality of flour
- Technology used, process needed certain flour

⇒ International Brabender® standards have been developed, are well defined and used worldwide over decades.

Standards are needed, to compare sample quality, „to speak the same language“ same procedures must be used.

...where quality is measured.
1928 The first Farinograph® was built

First wheat flour dough mixing instrument worldwide

84 years on the market - worldwide

...where quality is measured.
The following standards are used over decades worldwide:

- AACC method 54-21
- ICC standard 115/1
- ISO 5530-1

Important
The only instrument which meets these international standards is the Brabender® Farinograph®

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The C.W. Brabender® 3-Phase-System
4. Brabender® Farinograph®: Phase 1: Dough mixing

2012 Today: Farinograph® AT

Farinograph® AT

...where quality is measured.
Phase 1: Dough mixing

Key question: Water absorption and how stable is the dough during mixing?

- Water absorption
- Protein quality
- Enzyme activity (Proteases)
- Mixing stability

Farinograph® AT

AACC standard 54.-21, ICC standard 115/1, ISO 5530-1, 5530-2, …

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Example: Evaluation ICC 115/1 Farinograph®

Water absorption

Stability

Degree of softening

Development time 12 min

...where quality is measured.
Examples of flours

- Toast
- Rolls and bread
- Biscuit & cake
Evaluation of results

<table>
<thead>
<tr>
<th></th>
<th>Weak flour</th>
<th>Strong flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water absorption [%]</td>
<td>54 - 58</td>
<td>58 – 67</td>
</tr>
<tr>
<td>Dough development time [min]</td>
<td>&lt; 2,5</td>
<td>2,5 – 14,0</td>
</tr>
<tr>
<td>Dough stability [min]</td>
<td>&lt; 3,0</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>Degree of softening [FU]</td>
<td>&gt; 80</td>
<td>&lt; 80</td>
</tr>
</tbody>
</table>

...where quality is measured.
Usual standard mixers@ Farinograph®

Sigma mixer S 300 and S 50
- Standard test
- 300 or 50 g flour

Sigma mixer S 10
- For small samples
- 10 g flour

Hardness and Structure Tester
- Hardness of grain (wheat, maize/corn, barley, malt)

...where quality is measured.
1. Standard software to run international standard test like ICC, AACC or others

2. Additional software options beside the standard Farinograph® test (examples)
   - Correlation software
   - Variable speed (0-200 min⁻¹)
   - Create own speed profiles (Speed/times)
   - Create own temperature profiles
   - Create own evaluations/methods
   - LIMS – Lab Data management system

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The C.W. Brabender® 3-Phase-System
5. Brabender® Extensograph®: Phase 2: Dough resting and change of elasticity

Extensograph®

1972

Extensograph®-E

2012

…where quality is measured.
The following standards are used over decades worldwide:

- AACC method 54-10
- ICC standard 114/1
- ISO 5530-2

**Important**

The only instrument which meets these international standards is the Brabender® Extensograph®

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The C.W. Brabender® 3-Phase-System

5. Brabender® Extensograph®: Phase 2: Dough resting and change of elasticity

Dough homogenizer
Roll / cylinder former
Proving cabinets
Streching device

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Phase 2: Dough resting and stretching

Key question: Can the dough hold gas?

- Wheat: Time pending quality (time!)
- Dough properties/elasticity (time!)
- Enzymes, Baking properties (time!)

AACC standard 54-10, ICC standard 114, ISO 5530-2, …

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The C.W. Brabender® 3-Phase-System
5. Brabender® Extensograph®: Phase 2: Dough resting and change of elasticity

Extensograph Units [EU]

Energy
(Area in cm²)

Resistance to Extension
Extensibility = Ratio Number

Maximum

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Influences of additives – 5 concentrations

Ascorbic acid
- 25ppm addition
- 10ppm addition
- no addition

Proteinase
- no addition
- 5 ppm addition
- 25ppm addition

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### Evaluation of Extensograph® results

<table>
<thead>
<tr>
<th></th>
<th>Weak flour</th>
<th>Strong flour</th>
<th>Rigid, tough dough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy [cm²]</td>
<td>&lt; 100</td>
<td>110-130</td>
<td>120-140</td>
</tr>
<tr>
<td>Resistance to Extension [EU]</td>
<td>&lt; 300</td>
<td>400-600</td>
<td>&gt; 600</td>
</tr>
<tr>
<td>Extensibility [cm]</td>
<td>100-130</td>
<td>130-160</td>
<td>&lt; 120</td>
</tr>
<tr>
<td>Extension maximum [EU]</td>
<td>150-400</td>
<td>500-700</td>
<td>&gt; 700</td>
</tr>
<tr>
<td>Ratio number</td>
<td>&lt; 2,5</td>
<td>3,0-4,5</td>
<td>&gt; 5,0</td>
</tr>
</tbody>
</table>

…where quality is measured.
The C.W. Brabender® 3-Phase-System
5. Brabender® Extensograph®: Phase 2: Dough resting and change of elasticity

- Short, hard gluten
- The fermentation gas of the yeast could not extend the dough
  = Small pieces of bread with poor dough spring and hard crump

- Extensible, elastic gluten
- The fermentation gas of the yeast could extend the dough
  = Baking products with a good, nice volume and soft crump

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The C.W. Brabender® 3-Phase-System
5. Brabender® Extensograph®: Phase 2: Dough resting and change of elasticity

- Soft and weak gluten
- The dough could not keep the fermentation gas very well
- Low baking volume, but good for puff pasty!

- Very weak gluten
  = not suitable for normal baking products, maybe cookies

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Phase 3: Gelling of starch

Key question: Can the starch absorb the water during baking?

- Enzyme activity (Amylases)
- Gelling behaviour of starch
- „Video“ of starch gelling, not just picture

AACC standard 61-01, ICC standard 169
Standardized ICC/AACC/ISO Method:

A slurry of flour and water is heated by the instrument.

The viscosity of the sample is measured during the heating process.

An online diagram of viscosity versus time (temperature) is recorded.

The real temperature is always measured inside the sample.

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The C.W. Brabender® 3-Phase-System

Evaluation Amylograph test

- Gelatinization maximum
- Gelatinization temperature

Starting temperature 30°C
Heating rate 1.5°C/min

AU

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Standardized ICC/AACC/ISO Method:

Enzyme activity (Alpha-Amylase)

During baking, the protein releases water. This water needs to be bound.

Starch in „good“ conditions can absorb water during the heating/gelatinization process.

If enzymes are breaking the starch molecules too much, the water is more or less free and cannot be bound by the starch.

The crump of the bread may collapse (worst case), be wet and be of poor chewing properties.

A well balanced amylase activity is needed.
The C.W. Brabender® 3-Phase-System

Viskosität

AE

1000
800
600
400
200

Low enzyme activity
Enzym activity fine
Enzyme activity too high

Amylograph®-E

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1960 First AACC Methods

Amylograph

Extensograph®

Farinograph®

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Standard methods applied worldwide

- **AACC methods**
  American Association of Cereal Chemists; USA

- **ICC standards**
  International Association for Cereal Chemistry; Austria

- **ISO**
  International Organization for Standardization; Switzerland

- **National standards**
  CEN/DIN/, IRAM-Argentina / RACI-Australia / FTWG-Great Britain, GB/China
The following standards are decisive for worldwide and cross-border trade:

- AACC method 61-01
- ICC standard 169

Important
The only instrument which can meet these international regulations is the Brabender® Amylograph®

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The C.W. Brabender® 3-Phase-System
3. C.W.Brabender's vision: The 3 phase system

- **Brabender® Farinograph®**
- **Brabender® Extensograph®**
- **Brabender® Amylograph®**
Optimization /standardization of flour quality requires standard procedures and high quality instruments

With the 3 phase system flour can be well defined

Constant and good flour quality reduces waste in bakeries

Optimizations of technological processes are possible

Optimum and constant baking quality can be achieved

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Benefit for the user:

- Mill: Constant and better quality, higher flour price possible
- Bakery: Constant quality in products, higher market share
- Bakery: More baked goods by choosing better flours

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The C.W. Brabender® 3-Phase-System
High quality instruments for measuring high quality

Thanks for your attention

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